

TAXONOMY OF *STREPTANTHUS* SECT. *BIENNES*,
THE *STREPTANTHUS MORRISONII* COMPLEX
(BRASSICACEAE)

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ABSTRACT

The *Streptanthus morrisonii* complex is a six-taxon group of closely related serpentine rock outcrop endemics from Lake, Napa, and Sonoma counties of California, USA. Two new subspecies (*S. morrisonii* subsp. *kruckebergii* and *S. brachiatus* subsp. *hoffmanii*) from Lake County, California, are described. The relationship of these taxa to others in the section is reviewed and descriptions and a key are provided.

Floristic surveys of serpentine rock outcrops conducted for environmental impact reports for geothermal and gold-mining operations in Lake, Napa, and Sonoma counties of California, have revealed new data on many rare and unusual plants. During these surveys previously undescribed populations of plants were discovered that are clearly members of the section *Biennes* of the genus *Streptanthus* (the *Streptanthus morrisonii* F. W. Hoffman complex), and yet do not match the morphology or geographical distribution of the described taxa (Hoffman 1952). Some *Streptanthus* taxa restricted to serpentine are known for extreme local differentiation (Kruckeberg 1956, 1958). We undertook a study of the biochemistry, morphology, and distribution of the section to evaluate the existing taxonomy and to determine the taxonomic status of newly-discovered populations.

Hoffman (1952) first addressed the taxonomy of "biennial" (i.e., monocarpic perennial) *Streptanthus*. He collected and described two species, one with three subspecies. These plants grow on serpentine outcrops of limited access and had not previously been collected. Hoffman placed his taxa in the subgenus *Euclisia* Nutt. ex Torrey & A. Gray (*Streptanthus* with zygomorphic flowers, nonbracteate inflorescences, and one or two pairs of stamens with connate or partially connate filaments), that was monographed by Morrison in

1941. The biennial *Streptanthus* were recognized as section *Biennes* by Kruckeberg and Morrison (1983).

Members of the *Streptanthus morrisonii* complex have glabrous and glaucous vegetative parts. Their most distinctive feature is cabbage-like rosette leaves that are broad, palmately-lobed, fleshy or succulent, and often mottled on the adaxial surface. Succulent rosette leaves indicate the biennial life history characteristic of the group. Some related *Streptanthus* that grow on serpentine also possess fleshy rosette or basal leaves. This tendency toward succulence appears to be one of the suite of traits shared by serpentine endemics (Kruckeberg 1984a, b).

The newly discovered populations differ from the described taxa of the complex in morphological traits and/or geographic range. Plant habit, flower color, and leaf characteristics are the most significant discriminating traits. These features and genetic relationship as revealed by starch gel electrophoresis of enzyme variants (unpubl. data) support the taxonomy of the section as developed by Hoffman (1952) with the addition of two new subspecies; one each for *Streptanthus brachiatus* and *S. morrisonii*. The relationship of these subspecies to other members of the complex is presented in the following taxonomic treatment. Type localities for the taxa are mapped in Figure 1. Additional collection sites are in the immediate vicinity of the type localities for these extremely restricted endemics.

STREPTANTHUS Nutt. sect. BIENNES Kruckeb. & J. Morrison, Madroño 30:242. 1983.

Glaucous and glabrous biennials, low (20 cm) to tall (75–125 cm), the first year rosettes of petiolate, broadly spatulate, and coarsely dentate leaves. Flowers in openly branched racemes or panicles, zygomorphic; calyces flask-shaped; sepals glabrous or setose, yellow to purple, carinate; petals white to salmon-colored, crisped, unequal, recurved; stamens in 3 unequal pairs (upper, lateral, and lower), the upper with connate filaments, strongly recurved upward, the lower set partially connate and recurved downwards. Siliques erect, divaricate or reflexed, usually torulose; seeds only weakly winged at tip; cotyledons accumbent.

KEY TO TAXA OF SECTION *BIENNES* OF *STREPTANTHUS*

- A. Plants short (10–30 cm) and much branched near the base. 1. *S. brachiatus*
 - B. Calyces glabrous, rose-purple; endemic to the immediate vicinity of Socrates Mine, Sonoma County. 1a. *S. brachiatus* subsp. *brachiatus*
 - B. Calyces usually pubescent, yellow or dark purple; endemic to the Sulphur Creek drainage on Lake/Sonoma county line. 1b. *S. brachiatus* subsp. *hoffmanii*
- A. Plants tall (30–100 cm) and remotely branched. 2. *S. morrisonii*
 - C. Calyces densely pubescent with long (2 mm) hairs, dark purple; endemic to the headwaters of East Austin Creek, Sonoma County. 2a. *S. morrisonii* subsp. *hirtiflorus*

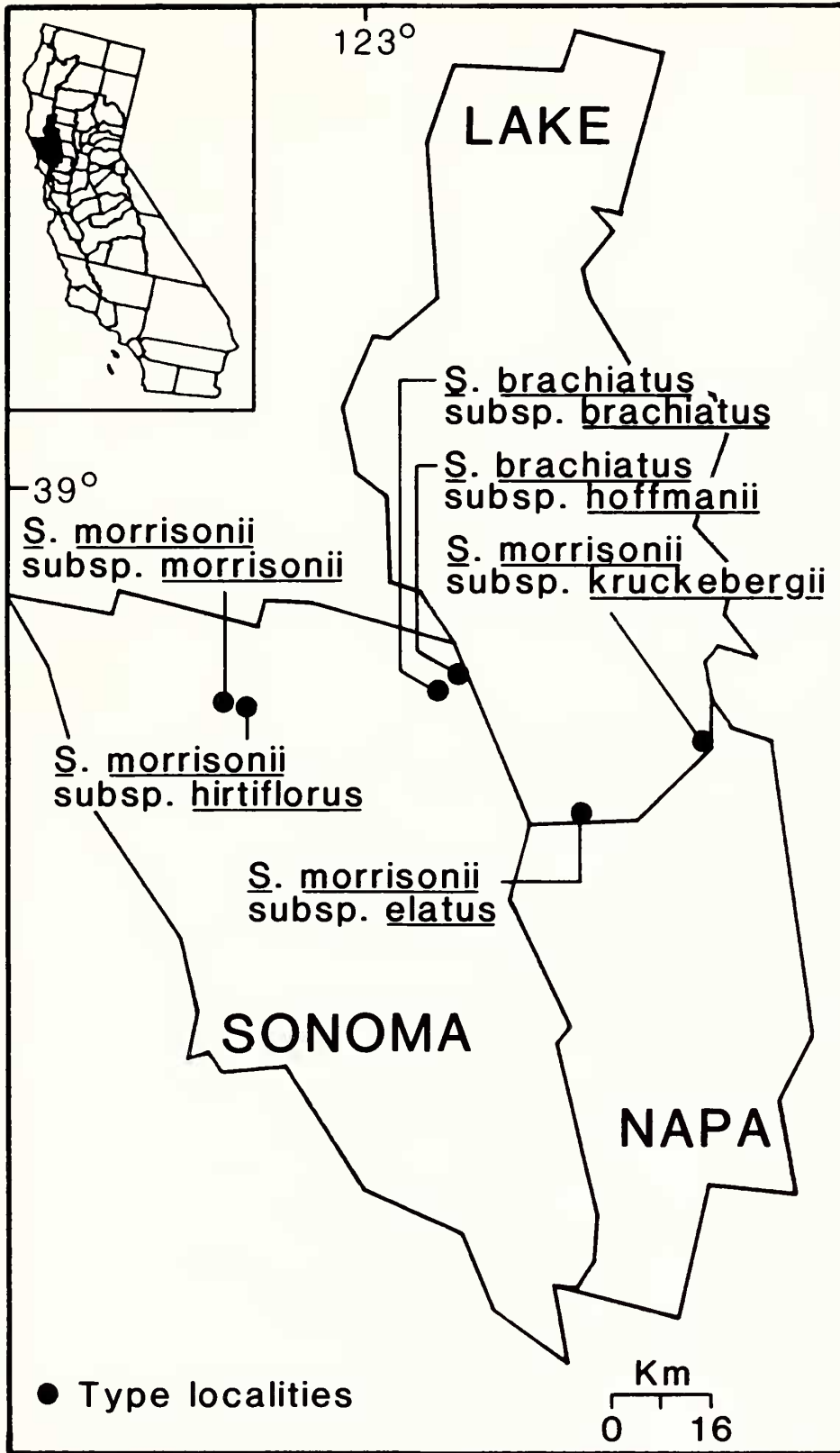


FIG. 1. Map of type localities of the *Streptanthus morrisonii* complex.

- C. Calyces glabrous to slightly pubescent, greenish yellow to golden yellow.
- D. Upper and lower surfaces of rosette and lower cauline leaves usually green; upper connate filaments uniformly orange or orange-yellow; endemic to drainage of Big and East Austin creeks, Sonoma County. 2b. *S. morrisonii* subsp. *morrisonii*
- D. Upper surfaces of rosette and lower cauline leaves heavily mottled with purple-brown, lower surface uniformly purplish; upper connate filaments uniformly yellow.

- E. Upper cauline leaves 2–4 times as long as wide.
 2c. *S. morrisonii* subsp. *elatus*
 E. Upper cauline leaves 1–2 times as long as wide.
 2d. *S. morrisonii* subsp. *kruckebergii*

1. **STREPTANTHUS BRACHIATUS** F. W. Hoffm., Madroño 11:230. 1952.

Rosette leaves gray-green, mottled with purple-brown above, uniformly purple beneath. The original stem extending the second year and producing more or less brachiate branches bearing short-petiolate and sessile, undulate, auriculate, orbicular to orbiculate and oblong-spatulate, prominently veined leaves with entire or coarsely serrate margins or with the margins entire basally and serrate apically, passing into narrowly-lanceolate usually toothed bracts. Flowers in discrete racemes, bracteate or not. Calyces glabrous or sparsely pubescent and reticulate with fine lines, rose-purple with yellowish base or purple or yellow. Sepals broadly lanceolate. Upper connate filaments orange-colored with two longitudinal, purple lines. Chromosome number unknown.

- 1a. **STREPTANTHUS BRACHIATUS** F. W. Hoffm. subsp. **BRACHIATUS**. —
 TYPE: USA, California, Sonoma–Lake county line, E of Pine Flat, exposed serpentine ridge near Contact Mine, 3000 ft, 5 Jun 1949, *Kruckeberg and Hoffman 1905* (holotypes, UC!).

Flowers glabrous; calyces rose-purple with yellowish bases; mature upper connate filaments orange with two longitudinal purple lines.

Streptanthus brachiatus subsp. *brachiatus* is known only from the immediate vicinity of Socrates Mine on the Sonoma–Lake county line (Fig. 1). According to H. K. Sharsmith (specimen annotation 8, Oct. 1952), the type locality is near the junction of Socrates Mine Rd, with Pine–Flat–Middletown Rd on ridge W of canyon of Big Sulphur Creek, Sonoma County. The Napa–Lake county line is on ridge east of canyon of Big Sulfur Creek.

Additional collections. USA, CA, Lake Co., near Contact Mine, E of Pine Flat, on the Sonoma–Lake county line, 3000 ft, *Kruckeberg and Hoffman 1905* (UC); same area, *Hoffman 3436* (UC); summit of ridge about 0.5 mi S of Mercuryville on rd to Big Geysers, *Hoffman 3379* (UC); Sonoma Co., near junction of Socrates Mine Rd with Pine–Flat–Middletown Rd, Mayacamas Mts., 3200 ft, *Sharsmith 4129* (UC).

- 1b. **Streptanthus brachiatus** F. W. Hoffman subsp. **hoffmanii** Dolan & LaPré, subsp. nov. —TYPE: USA, California, Lake County near Sonoma county line on Bear Ridge Rd ¼ mi S of three-way junction with Ridge Rd and Davies Rd, on serpentine outcrop near a geothermal expansion joint, 2 May 1985, *LaPré s.n.* (holotype, UC; isotypes, CAS, RSA, UC).

Herbae 10–30 cm altae probe basin ramosissimae; calyces plerumque pubescentes, lutei vel atropurpurei.

Flowers glabrous to pubescent and variable within a population. Calyces purplish green to greenish yellow. Mature upper connate filaments yellowish with two dark-colored longitudinal lines.

This taxon occurs on isolated serpentine rock outcrops, occasionally scattered in adjacent chaparral, near the Lake–Sonoma county line (T10N R7W and R8W) primarily in geothermal development areas, from the junction of Ridge Road, Davies Road, and Bear Ridge Road off Socrates Mine Road, S to Buck Rock and SE to Mount St. Helena (Fig. 1). Populations are morphologically uniform within single outcrops but much local differentiation is present between outcrops, even those in close proximity. Calyx color varies most prominently (from purple to yellow) along with stature (from short to tall) along the line from the northwest to southeast. Populations in the southeast nearest the location of *S. morrisonii* subsp. *elatus* tend to converge on morphological characteristics of that taxon.

Species growing on the serpentine outcrops with *Streptanthus brachiatus* subsp. *hoffmanii* include the rare plants *Eriogonum nervulosum* and *Allium falcifolium*. Growing on the margins of the outcrops in the more weathered serpentine are *Pinus sabiniana*, *Arctostaphylos viscida*, *Cupressus sargentii*, *Quercus durata*, *Solanum parishii*, *Fremontodendron californicum* subsp. *napense*, and *Ceanothus jepsonii*.

This taxon is named in honor of Freed Hoffman, an amateur botanist, of Guerneville, CA, who specialized in serpentine flora. He was the first to collect *Streptanthus* in “The Geysers” region.

2. *STREPTANTHUS MORRISONII* F. W. Hoffm., Madroño 11:225. 1952.

Rosette leaves uniformly gray-green above and beneath, or the lower surface somewhat purple-tinged, or the upper surface heavily mottled with purplish or brownish blotches and the lower surface purple. The stem, in the second year, extended and producing auriculate-spatulate to auriculate-ovate, sessile, clasping, entire or few-toothed leaves, these passing into auriculate-lanceolate acute, sessile leaves and awl-shaped bracts. Flowers scattered along the flowering stems or concentrated towards the tips of branches. Calyces densely pubescent, with a few scattered hairs, or entirely glabrous, yellow to purple. Sepals ovate-lanceolate. Upper connate filaments uniformly yellow or orange with two longitudinal purple lines when the calyx is purple. Chromosome number unknown.

2a. *STREPTANTHUS MORRISONII* F. W. Hoffm. subsp. *HIRTIFLORUS* F. W. Hoffm., Madroño 11:228. 1952.—TYPE: USA, California, Sonoma County, on bluffs and cliff talus, serpentine soil, above

Dorr's Cabin, headwaters of East Austin Creek, 17 Jun 1948, *Hoffman 2344* (holotype, UC!).

Flowering stems strict or much branched and diffuse, up to 80 cm tall. Juvenile leaves heavily mottled with purple-brown above, uniformly purple beneath; upper stem leaves auriculate-spatulate to auriculate-ovate, sessile, clasping, entire or few toothed. Flowers abundant, scattered along the flowering branches. Calyces red-purple, abundantly clothed in long hairs (2 mm long) which gives the plant a grayish appearance. Petals dull white with purplish veins. Upper connate filaments orange, with two longitudinal, purple lines.

Streptanthus morrisonii subsp. *hirtiflorus* grows on serpentine bluffs and talus slopes with western exposure. This rare serpentine endemic occupies an area of not over 100 m² on west-facing serpentine bluffs and slopes at the headwaters of East Austin Creek, a short distance above Dorr's Cabin, Sonoma Co., California (Fig. 1). It has not been collected elsewhere.

- 2b. *STREPTANTHUS MORRISONII* F. W. Hoffm. subsp. *MORRISONII*. — TYPE: USA, California, Sonoma Co., serpentine outcrop, head of Big Austin Creek at Layton Mine, 26 Sep 1946, *Hoffman 1020* (holotype, UC!).

Flowering stems strict, 20–60 cm tall. Juvenile and adult leaves gray-green on both surfaces, or slightly purplish beneath, without maculation. Upper stem leaves similar to those of subsp. *hirtiflorus*. Flowers discretely produced toward the tips of the ascending or divergent branches. Calyces greenish yellow becoming golden yellow with age, glabrous or with a few scattered hairs. Petals creamy white to light salmon with brownish or orange-colored veins. Upper connate filaments uniformly orange.

This taxon occurs on serpentine outcrops in "The Cedars" area of northern Sonoma County, along the drainage of Big Austin Creek and its tributaries (Fig. 1).

Additional collections. USA, CA, Sonoma Co., headwaters of Big Austin Cr. at Layton Chromite Mine, *Hoffman 1020* (UC); Layton Mine, Austin Cr., *Hoffman 1027* (UC); near headwaters of Devil Cr., The Island: tributary of upper East Austin Cr., *Hoffman 2995* (UC); trail from Gray Cr. to The Island, headwaters of East Austin Cr., *Hoffman 3360* (UC); The Cedars, headwaters of East Austin Cr., 700–2000 ft, *Raiche 30581* (JEPS).

- 2c. *STREPTANTHUS MORRISONII* F. W. Hoffm. subsp. *ELATUS* F. W. Hoffm., Madroño 11:228. 1952. — TYPE: USA, California, Napa-Lake county line, ¼ mi W of White's Point, Table Mountain Rd, ca. 5 mi E of Mountain Mill House, 3 May 1947, *Kruckeberg 1438* (UC!).

Flowering stems strict, remotely branched, 35–105 cm tall. Juvenile leaves with upper surface mottled with purplish brown and lower surface uniformly purple, blades long-petioled, obovate or flabelliform, prominently veined, with margins entire basally and coarsely dentate distally. Upper stem leaves oblong-spatulate, cymbiform, clasping. Flowers produced toward the tips of ascending branches. Calyces greenish, turning golden yellow with age, glabrous or sparsely pubescent. Petals white, turning yellowish with age. Upper connate filaments uniformly greenish yellow.

Known only from several closely spaced serpentine outcrops near Three Peaks and White's Point on the Lake–Napa county line (Fig. 1).

Additional collections. USA, CA, southern Lake Co., along ridge from White Pt, near Napa–Lake county line, 2.7 mi E of Mt. Mill House, 2500 ft, *Hoffman 2906* (UC); *Hoffman 2872* (UC); rosettes grown from seed collected at White Pt, *Hoffman s.n.* (UC); Hoffman Cr., about 1 mi E of Mirabel Park, *Raven 010745* (UC).

2d. *Streptanthus morrisonii* F. W. Hoffm. subsp. *kruckebergii* Dolan & LaPré, subsp. nov.—TYPE: USA, California, Lake Co., Dunnigan Hill in Knoxville Recreation Area (T11N R5W, sect. 11), on serpentine outcrop, 8 Jun 1985, *LaPré s.n.* (holotype, UC; isotypes, CAS, RSA, UC).

Herbae 30–100 cm altae, remote ramosae, folia rosularia maculata purpureobrunneis in superioribus paginis, uniformiter purpurea in paginis inferis; folia caulina superiora 1–2plo longiora quam latiora; calyces glabrae vel leviter pubescentes, viridiflavae; superiora filamenta connata uniformiter lutea.

Flowering stems remotely branched, 20–115 cm tall. Juvenile leaves green with punctations above, uniformly purple beneath. Upper stem leaves oblong, spatulate, cymbiform, clasping, often deciduous before flowering. Flowers produced toward the tips of ascending branches. Calyces yellowish green, turning bright yellow with age. Petals creamy white. Upper connate filaments uniformly greenish yellow.

This new subspecies is a morphologically uniform taxon. The plant occurs on scattered serpentine outcrops near the Lake–Napa county line, primarily in the Knoxville Recreation Area (T11N R4W), Dunnigan Hill region, and associated watersheds (Fig. 1).

Species associated with *Streptanthus morrisonii* subsp. *kruckebergii* include *Eriogonum nervulosum*, *Allium falcifolium*, *Streptanthus breweri*, and *S. hesperidis*. *Pinus sabiniana*, *Arctostaphylos viscida*, *Cupressus sargentii*, *Quercus durata*, and *Ceanothus jepsonii* grow in the adjacent chaparral.

This taxon is named in honor of Dr. Arthur R. Kruckeberg, leading expert on the serpentine flora of the western United States.

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